TRANSACTIONS OF SOCIETIES.

Art. X.—*Summary of the Transactions of the College of Physicians of Philadelphia.*

March 2. *Effect of Respiration on the Size of the Heart.*—Dr. Da Costa read the following note in continuation of a previous paper:—

Several months ago, when conducting some observations respecting the influence of the respiration on the position of the heart, I was struck with the very decided change which occurs in the sounds and in the extent of percussion-dulness during a held expiration. The dulness increases markedly, especially in an upward and transverse direction; the sounds, particularly the first, are manifestly altered. The question presented itself to my mind, how far these phenomena were due to a mere change of position of the heart and the adjacent borders of the lung, or how far they might be owing to a distension of the heart during the prolonged expiration?

To arrive, if possible, at some conclusion on this subject, I instituted a series of experiments, with the kind aid of several professional friends, and especially am I indebted to Drs. Brinton, Kane, and Hammond, for their assistance.

Experiment.—A rabbit was etherized, and the operation of tracheotomy performed. The heart was previously listened to, and its action was observed to be very rapid; the chest was then laid open and the organ exposed. On cutting away the pericardium, whilst respiration was kept up through a tube inserted into the trachea, it was immediately noticed that during a forced inspiration the left auricle and ventricle, and, indeed, the whole heart, as far as it was exposed, appeared small; whilst, when the stopcock of the tube was turned off during an expiration, both the ventricle and auricle were distended to almost twice the size they presented during a full inspiration. The longer this state was kept up the greater became the tumefaction on both sides, until it finally seemed as if the heart would burst. But a full inspiration relieved it, and it returned to its former shape. By careful dissection, a view of both sides of the heart was obtained, and the same appearances were recognized on the right side; that is, like on the left side, when the lungs were permitted to sink back and the breathing stopped, the ventricle and the auricle swelled enormously, but immediately diminished when the pulmonary tissue was again filled with air. The effects of a continued and held inspiration were not particularly studied, but it was specially noted that the same phenomena described as occurring in expiration were obtained by pressing on the lung, and emptying it mechanically of the air it contained.

Exp.—The same experiment was repeated on another rabbit, and with the same results. The swelling of the auricles was not as marked; that of the ventricles was. It was especially noticed that during the fixed expiration the ventricles were distended both during their contraction and relaxation, and that the action of the heart became very laboured. The point of the heart appeared rounded.

Exp.—On a frog, I was enabled to ascertain the precise difference in the size of the heart during a fixed expiration and inspiration. The two auricles measured in their transverse diameter 17½ mm. during a full expiration; 16 when the lungs were moderately filled with air; 15½ in a full inspiration, and only 14 mm. during the most expanded state of the lung. The ventricle varied by 2 mm. during the extremes of the acts of respiration.

Now these experiments certainly prove that during a protracted state of expiration, in which the blood is but imperfectly, or not at all, aerated, *both* sides of the heart become clogged with blood.

Exp.—To enable me to study the succession in which this distension occurs, Dr. Brinton separated the sternum of a dog which had been poisoned with woorara. Artificial respiration being kept up, we noted the following: "The rapidity of the heart's pulsation, immediately after the stoppage of the breathing, and whilst the lungs are moderately collapsed, is the same as before—28 beats in ten seconds. Both ventricles become somewhat swollen soon after the respiration is discontinued, but we cannot decide which, if either, begins to swell first. On the right side, the auricle and the ventricle both swell, and, we think, without being too positive, that the ventricle commences to swell before the auricle; *we are sure of it as regards the left side.* The pulmonary artery enlarges considerably before the pulmonary veins or the left auricle. At a later period the left auricle and the pulmonary veins increased in size almost simultaneously, but the auricle first. Blue blood appears in the pulmonary veins and on the left side of the heart before there is any excessive swelling of any part of the organ. As the pulmonary artery becomes engorged, a well-defined clacking noise is distinctly audible."

I repeated this experiment some time afterwards on another dog, so as to satisfy myself as to the relative time of swelling of the ventricles, auricles, and pulmonary artery, and observed exactly the same.

It demonstrates that when air is prevented from entering the lungs, and they recede, both sides of the heart distend—the ventricles before the auricles, the pulmonary artery before the pulmonary veins. It is not, nor indeed are any of the observations, conclusive as to what takes place during a fixed inspiration; but it is as to what happens when the breathing is arrested whilst the lungs are only moderately distended with air. The question now arises, and a difficult question it is to solve, in how far is it probable that the same phenomena occur in man during a fixed expiration? Can we, taking the experiments just detailed as a starting point, assert that they occur at all? Now I am perfectly aware that no such states, precisely as those described, can in the human subject supervene on the prolonged expiration. I am perfectly aware that in experiments on the respiration of animals we have to take into account the element of asphyxia; that on the one hand the altered pressure on the thoracic viscera and the more perfect collapse of the lung, which the introduction of air into the cavity of the chest occasions, is very different from the ordinary condition of things; and that the movements of a healthy human chest are not the same as the thoracic movements in an animal whose breast-bone has been removed. But the visible enlargement of the ventricles, when the respiration is stopped, occurs so rapidly that I cannot but think that the same takes place during a fixed expiration in man, although perhaps to a less degree. There are other facts which render this extremely likely, namely, the swelling of the jugular veins, during a full expiration, and their diminution in inspiration; the changed character in expiration of the pulse, which is apt to quicken, and still more constantly becomes much feebler, not only at the wrist but in the temporal arteries. We can add to these that at the same time the impulse of the heart becomes more distinct and extended, and the sounds alter in character, over the left as well as over the right ventricle.

I should speak more positively on the subject were I able to say more positively what is the exact mechanical effect of the acts of respiration on the pulmonary circulation. The opinions of careful physiologists vary widely on this point; yet the weight of argument seems to lie on the side of those who maintain that in expiration the circulation through the lung is accomplished with some difficulty. If so, the explanation of the enlargement of the heart would be this: The circulation is somewhat obstructed in the lung; the right heart becomes engorged; the blood flows to the left side; but it does not leave it very freely, because it is not very perfectly aerated if the expiration is continued a long time.

This, too, will only be admitted if the analogy with what occurs in experiments on asphyxia in animals be admitted; and if it be conceded that the hindrance to the flow of blood in this state occurs to a great extent by the capillaries all over the body refusing to receive the impure blood the heart injects into them—a fact which some of the experiments of Dr. John Reid render more than highly probable. Or, not to go as far as this, I will say that if there is any reason why the general capillary circulation should be retarded during a fixed expiration, it will explain why the blood accumulates in the heart and venous system, and does not pass as freely into the smaller arteries.

There are other points regarding the pressure on the walls of the arteries and veins during the acts of respiration that have been elucidated by the labors of Magendie, Poiseuille, Ludwig, and Donders, which ought to be taken into account. But I shall not now enter further into the subject.

The difficulty of drawing conclusions on a matter as complicated as this is very great. Nor do I intend them to be final. I have merely wished this evening to call the attention of the College to them, in hopes of being able at some future time to furnish more extended data.

I cannot, however, leave this subject without alluding to the erroneous view, still so prevalent, that in asphyxia the blood collects in the venous system and on the right side of the heart, and that the non-aerated fluid does not reach the left side of the organ. If the experiments above detailed prove nothing more, they certainly prove how faulty is this still generally received doctrine; they certainly show that black blood may distend the left side of the heart. Whether the same phenomena occur if asphyxia is brought on whilst the lungs are fully inflated, I cannot say, since I have not as yet studied that question. But I can say that, if they do occur, they are not produced so quickly.

Arsenic in Obstinate Chronic Bronchitis.—Dr. WOOD observed that his attention had long since been attracted to the probable existence, in certain cases of obstinate chronic inflammation, no matter in what part of the body it might be situated, of the same state of system which gives extreme obstinacy to some cutaneous eruptions, such as psoriasis and lepra. This view is of practical importance; as arsenic, having proved a most effectual remedy in the cutaneous affections alluded to, might be equally beneficial in obstinate chronic inflammation elsewhere, if possessed of the same systemic character. The idea is not a new one. Professor Simpson, of Edinburgh, having been led to the supposition that a certain obstinate affection of the bowels, not uncommon in that city, was of a nature similar to cutaneous eruptions, employed arsenic in it with very beneficial effect. The same remedy has been long employed in obstinate periostitis, and with great asserted benefit in chronic nodosities of the joints of a rheumatic character. I have frequently thought of using it in chronic bronchitis, which had resisted ordinary treatment, but never carried the idea into effect until, in a case of nine or ten years' duration, which came under my notice some time since, connected with psoriasis of the face, I had a fair opportunity of trying the remedy. Under the use of Fowler's solution, in the dose of from three to five drops, three times a day, continued for six or eight weeks, the cutaneous eruption and chronic bronchitis were both so much relieved that the remedy was discontinued. Indeed, both affections had almost, if not quite, disappeared; and the patient had not been equally free from his bronchial affection at any time for years before. In consequence, however, of apprehension of injury to the stomach, not well founded